Trends and Future for Enterprise Integration

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***Abstract*—This is no surprise that the businesses today depend heavily on information technology than they ever did. It is one of these technologies that have made interoperability, interconnection and knitting of applications an easier task. EAI is the combination of hardware and software to share data and process in manner undisturbed and unrestricted for those applications and data files that have been so integrated. this research report attempts to look at the evolution of EAI and the challenges that it faces presently and in future.**

***Index Terms*—Enterprise integration, trends, service bus.**

I. Introduction

Since quite some time, there has been constant and drastic changes the way organizations work. In fact the way they are built and grown is a completely different approach to what used to be. Technological advances have become a major deciding factor in everything that is done, from internal processes to external situations that organizations go through. Every process has become much more interconnected and every environmental factor has become much more dependent on the extensive interconnection of the processes. Not only are the processes different that need to be assimilated but also the technologies are divergent.

As more innovations come into place in the market mechanism, products, customer needs, technological inventions; organizational processes have shortened up, structures have shrunk, products are rendered obsolete, that is, shorter product lifecycles, organizations have moved hastily towards integration of applications, databases, information, software's, leading to cost effective solutions to save up resources and time.

Enterprise Integration is the amalgamation of the hardware, software, information and other resources with the use of technology to create an impactful, resource driven organizational processes. It is simply a technical field where the systems are interconnected so instead of the data being collected at a central location and then according to use taken out of it, the right information is available at the right time it is needed, for the right person.

II. Historical Background

The emergence of the concept of integration of applications and hardware and software systems began with the use of Computer Integrated Manufacturing, although the idea had existed since the computer stepped into the world. CIM is the control of production process through computers leading to a more defect free operations and speedy manufacturing.

It was 1990s when the experts started focusing on the concept of integrating the business applications and enterprise systems. There were many factors involved in the development of this concept and bringing it to life. Largely because there was need for such a transformation and technology had reached that stage where it a development as this was possible. There was enough support from research end. Commercialization was seen an easy possibility and experts were handing out products that were making it come true, though not the way it is now.

As far as the need was concerned, it was definitely there, management and companies were stepping into a paradigm shift where information and communication was essential and that it was needed not just internally but for external working of the organizations.

This technical term had existed since the very beginning but it was when the evolution in technology that encouraged the idea that such an application of it could become a solution to the problem ever existing. It is simply an approach to use the already existing technology to make the most of it.

The main objective was to provide businesses and organization that are using separate systems for supply chain, customer relation, financial models and systems, Human Resource Information Systems ability to interoperate. This was done to provide information alignment to organizational infrastructure. Bringing together the individual working functions of an enterprise leads to easy adaptability of the changing business environment as well as quick implementation of changes in the technology as it comes about [1].

The expert minds that initially built these systems concentrated mainly on the collection of information and data integration, identifying the data sources that lead to the development of such an application.

Data gathering has become rather competitive in a world where customer has been crowned as the king and companies feel the need to have customer information from multiple sources in order to tap the right ones. Enterprise Application Integration (EAI) was what filled the gap. It was thought of as a value creating application that would provide companies a competitive advantage.

Just when it started its journey, enterprise integration was not very convincing, although the need existed, it was to make sure to the rest of the world that this would be the solution to the problem and that the problem was wide, it was not easy to understand how one single application of technology could cover up for it all. The world was questionable on the fact of how a single application that was initially not thought of for the purpose that it later got convincing people for would actually solve an information

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related query when even mature and sophisticated data warehouses and tools existed.

On the next step, another problem that came up was for integration to be done vertically or would the horizontal integration be a better idea. Going horizontal would have a single platform for different functions or to provide a specific platform to a specific function. Keeping customer perspective in mind, this would be an inconvenience on customer's part in getting the service they expect.

Just as a technology is evolving, there comes a point where a simpler tool leads to a more complicated situation. When integration was the focal point of discussion, information became essential and so information integration became the center. Information from all platforms was extracted but problem arose when that information was needed at the right place at the right time, this made the process redundant and repetitive, which then led to technology to mature slightly more into Enterprise Application Integration. The data had to be constant updated through enterprise information integration into EAI. To deal with any information related query, EAI is the end destination.

III. Objectives of EAI

Enterprise integration aims to ease out the following functions in a business

1) Enterprise information integration is a sub part of EAI, hence EAI seeks to collect data from multiple sources and make it persistent and logical.
2) It then aligns the process being carried out across the different functions of a common business such as supply chain, procurement, human resource, marketing, customer service and others.
3) Adjusting EAI for adaptability of vendors or business partners applications so the platforms needed for EAI to work are not hindered because of difference in applications.
4) It saves its end users the difficulty of having to learn a whole range of different applications since it provides a single solution/application to get access to all sorts of information available inside the organization.
5) It is not only easily developed but also has reduced cost of up keeping it or say upgrading it as the technology advances or as the need emerges. It reduces the cost levels.
6) If standardization is the objective throughout the organizational levels and applications then it is the optimal solution.
7) It reduces the time an organization takes to react/respond to a changing market mechanism. Also it reduces the time that the end product/service takes to reach the end consumers.

IV. Challenges Intially Faced by EAI

For EAI to be implemented and to enforce interoperability within an enterprise; there are a few factors that must be kept in mind and a few measures to be taken to eradicate the problems which are as such:

1) The different peripherals, components and devices that are working together have their individual formats and are differently tuned up in terms of language and operating system. This makes interoperability difficult task.
2) For data integration to happen there should be a uniform method or system for the flow of data to take place across all the functions.
3) Enterprise integration is a huge step that completely changes the structure of the business and so the program being implemented to do so must be strong and able to hold and the increasing customer flow and demand [2].

V. Tradinational Methods of EAI

Initially when EAI first got introduced, it worked on the having a common interface between the different applications within the organization. This it did in order for the information to be reused and remove the problems that would make usability of information minimal. This it did through consolidating two different databases. This simply means that the databases are so linked so they can be easily used by different applications. This is done through imitation of the entire databases on other databases.

The conventional model was the Broker model of EAI which made use of the central hubs, which are called 'brokers', resulting into infusion across all the functions.

A. How Does It Work?

Broker, which is the main engine for integration carries out all the functions of transforming the data from one database to another. Broker is the central location through which all the activities take place.

One advantage of this system is that it allows the users to monitor the data flow as it takes place. Another is that it is the most flexible system of the EAI application. It is the middleware that allows integration on either of the two levels; database level or application level.

An illustration of this could be understood, say, if any transaction takes place with the customer. this happening as soon as it enters the system triggers the respective actions and processes needed at the respective system such as; it could lead to status updating on sales, production, billing, accounts and any other that might be related to that particular happening.

The main mechanism behind this type of system is the that it reformats and transforms the respective action for the different systems that it sends for, according to the rules and predefined formats of those particular systems. It makes use of intelligent routing mechanisms so that the need of each separate system is understood and proceeded with accordingly.

Sometimes to connect with the similar packaged applications, software's exist which help build up connectors, easing up the process.

B. Advantages

The main advantage that this type of EAI integration allowed was that the work proceeded without the end user being disturbed. The work continues even if there is no

response and since it makes use of intelligent mechanism, it knows where the changes or actions need to take place. There were some actual benefits of too; products/services reached markets at a faster rate, better response from the customers since it led to automation and self-service, there was reduction in operational cost, more efficiency in processes because data availability became more effective. It also reduced infrastructure complexity replacing the point-to-point connections with stronger and expansive solution.

C. The Problems

The reason it became obsolete in many parts of the world and much upgraded version of EAI are now put to use, is because this method relies on the use of a single hub or 'broker' which is responsible for transmitting signals and data to their destination.

As the work load increases, there is a lot of data traffic, the broker gets heavy, the actions are delayed, work is slowed down and the whole system gets affected.

Every applicant has to pass through it since this broker acts as the center point and sometimes instead of getting slow, it often breaks down, the whole network is put down because of it.

VI. Evolution in EAI

At some point it was realized that although broker model worked really well for some, it largely failed because of the single hub problem that ultimately led to the failure of it. A single point of failure led to the end of the whole network.

A new, better and much advanced version of the broker model of this was needed which had properly defined architecture and that which presented with other alternatives. Keeping these in mind, 'Bus' approach was devised.

Bus Architecture

This approach is only slight different from the broker or hub and spoke approach. Instead of using a single hub and slowing down at the time of heavy workload, it seeks to transfer much of its work to other networks lest the main network breaks down. it works on the distribution principle and divides the load on other different networks, instead of a single hub.

For integration to take place the components are grouped and data could be transferred or handled anywhere within the network because there is more than a single network at work. It works efficiently across different geographically located regions.

Much work happened over the bus architecture and it soon evolved and operated each component resulting into development of necessary functions of transaction and error processing.

This led to even more flexible system which not only lightened the system, releasing the workflow but also more dependable, working on a definite pattern. the bus approach provided for little changes in the existing architecture and with additional work further transformed into what is known as 'ENTERPRISE SERVICE BUS' (ESB) [3].

VII. Enterprise Service Bus

Although this more advanced had many versions of it that were using the traditional EAI structure, working on the hub and spoke model, redesigned to be a little efficient and offer bus like processes and some built completely on bus architectures but they all have some common underlying principles and features.

1) It has the ability to transform data and information into the format which is also easily accessible by other applications.
2) The data and information is centrally gathered and so does not require the user of that information to know the point where the information has been collected. Had it been the case it would have hindered information usage since the information is collected from multiple sources.
3) Protocols that exist at every point protecting it could be different from where the information is coming from and to where that information is going to. This is a major problem, of course, but ESB seeks to eradicate the problem by transformation and conversion according to each protocol.
4) It has the ability to fill up for the missing data based on the data that has been received. it fetches the missing information before the information reaches the respective destination.
5) It has intelligent routing techniques and is able to go sequentially to the destination from where the request has been initiated.
6) ESB looks after the security issues, much similar to the protocol conversion function that it carries out. It ensures that while the application integration takes place, the security measures at each end point is also mediated. Besides this, it also aims to transport data from the source to the end user under high security layers.
7) Auditing is another objective of EAI solutions. Traditional methods were also equipped with the same functionality. ESB aims to simplify the working and so provides with constant control over the performance [4].

Why ESB Is Preferred?

There were definite flaws in old methods of EAI which the ESB architecture seems to avoid.

1) It makes use of more than a single network and so is lighter on traffic hence the processes are easily and quickly carried out. it has the potential to take on more workload than previous version.
2) Because it takes into use alternative networks, it provides space for increasing end user demand and work pressure and hence this makes it stronger and able to work across larger boundaries.
3) Not only is it able to take the increasing demands but also very easily allows integration with newer systems that need be linked to the existing systems of an enterprise. because everything does not relate to the central broker, expansion has become rather easy.
4) Albeit the ESB structure is a complicated thought, it is not so. It has a wide range of uses and functionalities attached to it but it does require all of it to be out to use for it to work properly. In fact it is a good sign that it has wide range of uses to it so that when the

organizations grow in their need and structure it makes use of it. this is the 'flexibility' aspect of ESB.

5) This evolved version is based on SOA (service oriented architecture), that is, providing for services to end users irrespective of which platform is held at the other end. It's easy for the organizations working to shift on the SOA approach.

Although there are flaws to even this approach of EAI but this depends on the vulnerability of the factors which play alongside of it as it is being implemented. Whatever approach is chosen it must be a clear decision keeping in mind all the factors or the stage at which the organization is. EAI is a sophisticated use of technology and so must be enforced keeping in mind the following aspects.

1) the number of applications that will need to be integrated.
2) the protocols that are to be used in the functioning of such a system.
3) how strong and robust does my system need to be.
4) what the near/immediate future requirements of the enterprise would be.
5) will there be much integration of more applications if the need grows.

VIII. EAI Patterns

There are some patterns on which EAI works.

A. Integration Pattern

There are two sub-classifications

Mediation: the EAI becomes the broker and similarly, as an event takes place in any single point or application, an action is triggered to rest of the application, that are related to that event that took place

Federation: as any query enters the network from the external environment, the EAI seems to make intelligent decisions by giving out only the relevant information

B. Access Pattern

It has access patterns for each case, for instance, when working on mediation pattern it tends to be working on a single task at point in time and starts on another just as the previous one has ended. While for federation pattern, the EAI tends to be concurrent, that is simultaneously resolving issues as it goes about.

C. Lifetime Pattern

The patterns that EAI tends to work on can last as short as possible for a task that is as simple as fulfilling data integration requirements between two end points, or as long as can be, depending on the kind of activity that it is going through [5].

IX. Current Trends in Industry

It is to no surprise that it has long been understood that the business world requires not just integration but integration at level of the enterprise/organization. Part applications and programs have evolved and commercialized at many individual level but a more centralized approach is needed that should cover up for the whole of the organization and all of its functions.

Data to any one application can be easily used in another and integration be made an easy job for the workflow to become consistent. In this regard, the current industrial trends are:

A. A Blanket Integration

Instead of working on point solutions such as one level being integrated at a time, it is better to knit a complete integration platform which should also fasten up the integration being done at individual levels [6].

B. Loose Coupling

This aims to loosely integrate the applications so that changes are implemented as they come about. When applications are tightly integrated flexibility is reduced and change becomes difficult to take place. For this purpose customized language, which is XML is now being used as a standard.

C. Outside – Inside

What is happening now is for integration to take place, industry norms are entering and being adopted by individual organizations so that integration becomes even easier.

X. The Challenges Being Faced

The biggest dilemma that the businesses today face is the ever increasing demand and expectation from the consumer end. This has in turn led them to rely more and more on the IT industry to develop advanced support tools that would help these companies respond to the change.

The IT industry on the other hand is constantly evolving based on the foundation of technology and applications previously established. They found EAI as the solution to a more centralized integration by bringing the existing platforms and systems together.

What hinders the speedy implementation is the already use of mainframe systems by majority of the large working organizations. For EAI to start working, it must start from these huge databases which are not an easy task. Mainframes lack a uniform standard and data in these warehouses can be worked with only the specific applications and systems designed for them only.

It must, first work on the uniformity of data formats by transforming it then get the applications connected by creating a communication platform that would work for all the different data systems and getting the processes and transactions aligned.

Although these problems arise in the implementation of these systems but apparently there are some problems that are considered greater than these issues [7].

Business Process Improvement

This has seen to be as the biggest challenge in enterprise integration with end users finding it difficult to merge old (existing) and new business processes. The management of these two different platforms has become difficult to a point where the theses users are now heading towards using Business Process Management – BPM.

The reason its modeling is intimidating is because

application integration has some hidden challenges.

1) Any application intended to be integrated has many originating points from where the data can enter. The first and foremost it has a database, and then there are interfaces such as a documenting style running on the propriety/vendor format or application programming interface. Determining which point works best for which type of integration is the first test in the process
2) Then comes the maintaining the data interconnections which are highly indispensable since it determines how the data is processed. there are many steps involved in storing and reviewing data in a sequence
3) Setting up the workflow has some its requirements that need to be fulfilled. Some processes have built in operations; many have some of these missing. What later becomes a chaos is when a target is not found in the record. Then there could be some existing records that do not get aligned with the new workflow and so the whole process is affected
4) As simple as it looks data when it enters the applications is coded in different formats and through different standards. It is highly important for it to be standardized for an integrated solution to emerge. The validity and regulation of data is prerequisite to the applications and hence the organizations to be integrated
5) It must be very strongly kept in mind while getting a business through integration that the processes and applications are prone to error. There must be strong and potent monitoring and management for any errors that come about in the process of integrating data and workflow. There must be a separate system looking after the error chances
6) There are some tasks that are required to be taken care of at the time when the organization going through the integration process, that is, during execution. It is important that the application is scalable and flexible that it holds to the integration that is taking place
7) Similar to the previous context it is also recommended that the applications that are being worked are such that can adjust to the construct of the integration process

Apart from these challenges that EAI faces before or at the time of integration, there are some challenges that are being faced by the IT industry. These problems are:

1) The industry norms are such that EAI does not get the lime light it deserves and is taken as just another trend that is prevailing and that should be introduced in the organizations for the sake of it. it is to be realized that the fullest advantages cannot be leveraged if EAI is looked up as just another sub-venture
2) While it is taken not so seriously, the idea of integrating business applications is often pursued without having any proper direction and strategy of how it should be done and how deep should it go according to at what stage an organization is.
3) Lack of a proper strategy ends up having lack of proper rules and regulations for monitoring and no guidelines or criteria for performance evaluation to see if the integration has brought about the desired results or if there are any errors in the process [3].
4) Due to this problem it is highly felt that the industry still falls short of the skills required for a fruitful integration. Also the internal affairs face politics and prejudices that the desired results are never really seen.

XI. What Future Holds

It is no doubt that the EAI architecture has come across a long journey passing through many stages and evolving at every single one. The business environment is ever changing hence the tools that it must be provided with in order to advance must also have the same pace. The advanced models and platforms must have those support tools incorporated.

So far, ESB is the most evolved architecture in the field of application integration but still has to worked and researched on. It is also surprising that the most evolved architecture is not any ideal solution but the traditional approaches are also sometimes seems to be liable in areas where their frequency matches with that of the situation at hand.

There are bright plans to develop EAI such that should eradicate the current issues being faced. What is being called as open EAI would help in setting the uniform standards and guidelines that would help better implementation of EAI. Then to combat the challenge of few experts and lack or monitoring of integration activities there Integration Platform as a Service in the pipeline which would centrally help building and maintaining of an integrated solution.

Such initiatives are being taken from expert end to end the challenges that occur before or after the runtime.

It is not just the experts that feel the need for better measures to be taken for a bright EAI future but also the management needs more compatible integration to those of their suppliers and customers.

There is much work on the employee level that needs to be conducted. They need to understand that the way they work must change significantly. Since each company that is interconnected to another company has its own formatted integration and for employees to be carrying that knowledge would become easier to make use of the technology.

Research must also be done on the level of automation and technology that should be injected in each type and stage of business and to get the right result compatible system requirements must be there [5].

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